Why Do We Need Human Dimensions for the FUTURE Program?

By Mitsutaku Makino and Keith Criddle

Introduction

Good scientific (biophysical or ecological) arguments for management actions are sometimes not accepted or implemented because of the perceived socio-economic or cultural costs. An integrated understanding of how ecosystem changes affect human social systems, and *vice versa*, is necessary to improve the stewardship of marine ecosystems. Therefore, increased attention must be paid to human dimensions and the integration of social science into marine ecosystem research, that is, recognition that marine systems are social-ecological systems (SES). In other words, recognition that ecological (or 'natural') systems and human (cultural, social, economic, socio-political, ethical, and management) systems are simply dimensions of a greater whole (Perry *et al.* 2010, Ommer *et al.* 2011).

The key questions in the second PICES integrative scientific program, FUTURE, also reflect this recognition. For example, FUTURE Research Theme 3 "How do human activities affect coastal ecosystems and how are societies affected by changes in these ecosystems?" is about anthropogenic pressures on marine ecosystems (questions 3.1, 3.2 and 3.3), and the impacts of ecosystem change on dependent human populations and the development of social strategies to cope with those changes (question 3.5). FUTURE Objective 2 is to convey research findings to society and to foster the engagement. To support these goals, the Study Group on *Human Dimensions* (SG-HD) was established in 2009 (and completed in 2011), and the Section on *Human Dimensions of Marine Systems* (S-HD) was formed in 2012. This article briefly explains two important factors which necessitate the integrations of human dimensions into FUTURE (governance effectiveness and the value system at the objective setting process) and presents, based on the results of SG-HD, examples of how social science works in PICES member countries.

Effectiveness of governance

Recent studies have begun to identify human dimension factors which contribute to the effectiveness of ecosystem governance. For example, strong community leadership, robust social capital, and well-designed incentive structures such as individual or community quotas play major roles in determining the success of fisheries management (Gutierrez *et al*. 2011). On the other hand, these incentive structures can have undesirable effects, depending on their specific design characteristics and the social conditions of people and communities (Allison *et al.* 2012). Human factors are key sources of uncertainty in ecosystem governance.

Stakeholder participation is an indispensable part of effective governance. For example, fisheries co-management studies often emphasize the importance of resource users' participation in the decision making process. When making decisions on marine ecosystem governance, in which the recipients of marine ecosystem services are very widely distributed in the society, enhancement of public understanding of science or outreach of marine ecosystem research is highly important.

Value system and conservation objectives

When selecting objectives for marine ecosystem or resource governance, human dimensions matter. Each marine sector views ecosystems in terms of its own economic, cultural and societal needs. Consequently, ecosystem conservation is "a societal choice" (Convention on Biological Diversity's Ecosystem Approach Principle 1), and that choice requires balancing diverse and conflicting interests. The value system encompasses the diversity of culture and the full range of economic, intellectual, emotional, moral, and spiritual satisfaction.

Natural resources are not fixed things. Their meaning and value evolves as humans develop the scientific and technical knowledge to transform them into useful commodities in the society and as humans ascribe intrinsic value to them (Zimmermann 1933). This is also true of the services we receive from the marine ecosystems. The famous drawing of Tokyo Bay (Japan) in the early 19th century (Fig. 1) depicts fishing as an integral part of daily life in a coastal community. This image accurately portrays widespread agreement that marine social-ecological systems ought to integrate human activities, but that the footprint of those activities should not compromise ecosystem function or the stream of ecosystem services.

Fig. 1 Fishing in Tokyo Bay, Japan.

Studies on human dimensions in PICES member countries

There are many social science methodologies which can contribute to understanding human dimensions of marine ecosystems. SG-HD conducted an initial review of social science applications to marine resources and ecosystem

governance in the North Pacific area. In this section, we introduce a sample of the results presented in the PICES SG-HD final report (PICES Scientific Report No. 39).

Marine Use Analysis based on anthropology, economics, and policy science is being conducted to develop the conservation objectives for the Pacific North Coast Integrated Management Area (PNCIMA), Canada. Similarly, Integrated Ecosystem Assessment (IEA), which models the linkages among ecosystem threats, management activities, and social and economic goals, has been adopted as a central tool for management in Puget Sound, USA.

In Japan, social surveys have been conducted to identify objectives and public policy demands, and to prioritize various uses of the Japanese Exclusive Economic Zone. Of all respondents, 83.3% chose "food production by fisheries," 54.4% – "generation of energy from tidal power or offshore wind power", 21.0% – "transportation", 8.2% – "recreational use" and 1.9% – "creation of space by land reclamation".

In China, MEGA-MES (Marine EcoloGical Assessment Group – Marine Ecosystem Service Evaluation Software) was developed to model the determinants of the nonmarket value of ecosystem services. The tool has been applied to regional studies of the Yellow Sea, the South China Sea, the East China Sea, and the Bohai Sea. Similar studies of Peter the Great Bay in Primorsky Kray, Russia, were used to estimate the potential lost value of ecosystem services as a result of the construction of bridges, *etc*.

In Korea, socio-economic attributes (including economic revenue, the structure of seafood markets, employment, *etc*.) and ecological attributes were integrated into a fisheries risk assessment framework, IFRAME (Integrated Fisheries Risk Assessment Forecasting and Management for Ecosystems), and used to model the social benefits of the large purse seine fishery and other fisheries. In Canada, the Environmental Accounting concepts are being applied to monitor and assess the economic importance, impacts, full costs and full benefits of governance.

Conclusions

The social sciences provide tools and concepts for approaching aspects of marine SES which are not addressed by the natural sciences. These methodologies and tools are just now beginning to be applied to marine SES in a variety of locations and at a variety of scales. We believe that the academic environment is ripe for the integrated social-ecological research needed to address the challenges of rapidly changing environments and evolving social and economic demands on ecological resources.

The social sciences have developed qualitative and quantitative analytic methods that can be used to examine what has occurred and to develop conditional predictions of what is likely to occur under anticipated future conditions and given alternative policy choices. With careful planning on both sides, these approaches and tools can be compatible with models developed for the natural sciences and *vice versa*. In that sense, social sciences can contribute to assessment of the social and economic performances of actual and contemplated governance measures. In particular, analytical tools developed in economics and environmental accounting can be used to quantify the "efficiency" and distributional consequences of specific management actions. In addition, tools in sociology, anthropology, psychology, *etc*. can be used to conduct analyses on social criteria such as "sufficiency", "fairness", and "appropriateness".

When implementing governance measures, scale is an important and non-trivial issue. Just as particular scales are appropriate for representing particular natural science processes, so too particular spatial, temporal, and organizational scales are most appropriate for reflecting the operation of governance institutions and stakeholder impacts and inputs. Upscaling and downscaling human systems is every bit as challenging as upscaling and downscaling natural systems, and integrating SES across scales will be especially challenging. Doing so will require the coming together of social scientists and natural scientists envisioned in FUTURE. Social science can improve the value of the information produced by the natural sciences, and natural science can improve the value of information produced by the social sciences for decision making, better management, and better understanding.

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